The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD – this document) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.

South Dakota Space Grant Consortium

Lead Institution: South Dakota School of Mines & Technology
Director: Edward F. Duke, Ph.D.
Telephone Number: (605) 394-1975
Consortium URL: http://sdspacegrant.sdsmt.edu
Grant Number: NNX10AL27H

PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The South Dakota Space Grant Consortium is a Capability Enhancement Consortium funded at a level of $430,000 for fiscal year 2014.

PROGRAM GOALS

Consortium Management: *To ensure quality and fairness in all Consortium programs and alignment with the needs of NASA, the affiliate organizations, and the state of SD.* **Fellowship/Scholarship:** *To administer a fellowship/scholarship program that offers educational and research opportunities to students from diverse backgrounds who are pursuing degrees in fields of science, technology, engineering, and mathematics (STEM) that align with NASA's mission and those of SDSGC affiliates.* **Research Infrastructure:** *To promote the improvement of research programs and capabilities of Consortium affiliates with an emphasis on the fields of aerospace, earth science, and supporting STEM disciplines.* **Higher Education:** *To build interdisciplinary programs related to NASA's Primary Space Grant Programmatic Elements at the state's institutions of higher education and to support related programs that serve to strengthen STEM education in South Dakota.* **Diversity of Participants:** *To model diversity in all Consortium programs and activities, with an emphasis on Native Americans, which make up the state's largest minority group.* **Workforce Development:** *To use the Consortium's statewide network of*

scientists, engineers, and educators to provide talented students with a pathway to careers that will contribute to a highly-trained and diverse workforce for NASA and expand the nation's research and development capacity. **Longitudinal Tracking:** *To acquire and maintain accurate longitudinal data on all students and faculty who have received significant support from SDSGC in order to assess the impact of the support on their education, career, and professional development.* **Minority-Serving Institutions:** *To ensure that Minority-Serving Institutions in South Dakota, which are exclusively Tribal Colleges and Universities, are represented in the planning and implementation of all Consortium programs.* **Precollege:** *To increase student and teacher awareness and access to education and career opportunities in aerospace, earth science, and supporting STEM disciplines.* **Public Service:** *To enhance public scientific literacy in aerospace and earth science; to complement community efforts in STEM education; and to inspire citizens of diverse backgrounds through the excitement of scientific exploration and discovery.*

PROGRAM/PROJECT BENEFIT TO OUTCOME (1, 2, and 3)

The following highlight reflects the impact of SDSGC programs in support of NASA Education Outcome 1: *"Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals."*

After completing a Space Grant-funded $10,000 internship at NASA JSC in 2012, that led to a rotation of three Pathways internships, **Ryan Brown**, SDSM&T student, Space Grant fellow, and US Army veteran, graduated with a B.S. degree in Computer Engineering in December 2014. In January 2015, Ryan immediately went to work at NASA JSC's Mission Control for a 1.5 year training period for his eventual job as a flight controller operating the computer console called CRONUS, which manages communications systems with the International Space Station and communication satellites orbiting Earth. Soon, an SDSM&T graduate and Space Grant fellow will be sitting at the control center of the world's only international orbiting outpost. SDSGC's management believes that in terms of a university's role and Space Grant's goal of placing students in important and cutting-edge careers, it doesn't get any better than that.

The following highlight reflects the impact of SDSGC programs in support of NASA Education Outcome 2: *"Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty."*

23rd Annual Aerospace Career and Education (ACE) Camp 2014 – Hosted at affiliate South Dakota State University (SDSU) every July, this four-day residential camp provides high school-aged students the opportunity to get an early start on aviation and aerospace careers. During the 2014 camp, 28 ACE Camp participants flew a Cessna 172 aircraft, spent two hours in the flight simulation lab, participated in NASA lessons taught by NASA Summer of Innovation educators, built/launched model rockets, and participated in other aerospace activities.

The following highlights reflects the impact of SDSGC programs in support of NASA Education Outcome 3: *"Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission."*

Journey Museum and Learning Center's *Journey into Space* – Although the following metrics are not counted in SDSGC's precollege participant numbers in order to avoid duplication, the following is an excellent example of a strategic partnership with an informal educational affiliate. Over the course of the Journey Museum's four-year project titled *Journey into Space* (funded for three years under a 2010 NASA Competitive Program for Science Museums and Planetariums "CP4SMP" grant and this past year by a Space Grant PIG project), NASA STEM planetarium programming was provided to 23,363 students in grades 2-12, 764 teachers and other adults, and 1,200 members of the general public.

PROGRAM ACCOMPLISHMENTS

The performance *Goals* for Fellowship, Research Infrastructure, Higher Education, Precollege, and Informal Education are listed above under "Program Goals." The specific *Performance Objectives* from Table G.3 and the Consortium's Strategic Plan included in SDSGC's FY2010 Program Plan that are applicable to the accomplishments listed below are given in *italics* at the start of each accomplishment.

NASA Education Outcome 1 Accomplishments

Fellowships/Scholarship

Annual Performance Objective: Statewide competition offered at all 10 higher education affiliates including three Tribal Colleges; emphasis on internships with NASA, aerospace industry, DUSEL, and EROS. [At least 55 awards ($1,000-$12,000); all awardees enter longitudinal tracking system; at least 10% minority and 40% female; at least three NASA interns and five EROS interns]

Sixty-six (66) applications were considered from students from seven (7) of the Consortium's universities in competition for funds provided under SDSGC's FY14 Fellowship/Scholarship Stipend Program, which was announced in November 2013. The FY14 "base award" budgeted $110,000 in NASA funds for fellowships/scholarships. SDSGC's Management Team reviewed the applications and made selections. Awards were provided to 42 students from seven (7) universities, including two affiliate Tribal Colleges Sinte Gleska University (SGU) and Oglala Lakota College (OLC). Twelve (12) of the 42 awardees were graduate level (28.6%); 30 undergraduate (71.4%). The Consortium more than doubled its goal of 10% of awards to minority students: 10 of the 42 awards (23.8%) went to minority students. Exactly 50% of the total number of awards, and 44.5% of the total dollar amount of awards, were provided to female students, exceeding the targeted goal of 40% of awards to females. Six student internships were provided at NASA Centers: Goddard Space Flight Center (GSFC) and Johnson Space Center (JSC) during FY14: four funded by Space Grant; two by NASA.

Research Infrastructure

Annual Performance Objective − (Research support) Support new and developing research, especially multidisciplinary and collaborative projects, in fields aligned with NASA's mission. [At least two SDSGC fellowships or scholarships are awarded each year for students to work on NASA EPSCoR or other NASA-related research projects.]

FY2014 Dark Matter Research Findings at SURF – The MAJORANA Demonstrator (MJD) Project is constructing and testing an ultra-sensitive array of Germanium (Ge)

semiconductor detectors in affiliate Sanford Underground Research Facility (SURF), in order to look for a very rare decay of the isotope Ge-76, neutrinoless double-beta decay. In FY2014, work began on two new experiment facilities at SURF.
Davis-Bahcall Scholarships at SURF - Two of the 10 Davis-Bahcall college freshmen selected for the summer 2014 program were funded directly by SDSGC, each with a $4,000 Space Grant stipend. The five-week program includes study US and Italian labs.
Frank Pesta, an Electrical Engineering graduate (MS) student at SDSU received an FY14 SDSGC research stipend for his project: *"Relative Radiometric Characterization of Landsat 8's Operational Land Imager using Vicarious Calibration Methods."*

Annual Performance Objective − Increase the participation of women and underrepresented groups in statewide research programs and facilitate their subsequent entry into STEM careers. [SDSGC fellowship/scholarship funds for research or design experiences at SDSGC academic institutions, EROS, and NASA Centers will equal or exceed 10% to minorities and 40% to females.]
Michelle LeBeau and **Camille Griffith**, both FY2014 Space Grant fellows from Tribal College OLC, continued research into the Ornate Box Turtle (*Terapene ornata*), an important species for the Oglala Sioux Tribe. **Trisha Gabbert** returned to GSFC during summer 2014 and then presented: *Investigating the impacts of surface temperature anomalies due to wildfires in Northern sub---Saharan Africa* at the Fall 2014 American Geophysical Union meeting. Space Grant fellowship applicant and minority student **Julian Brakins** presented his research to the SD Legislature at the Student Research Poster Session on March 5, 2015. Brakins also conducted a NASA-funded internship at JSC and has applied for another at GSFC. SDSGC provided $17,000 in Space Grant fellowship funding to SDSM&T Atmospheric Science graduate student **Jorel Torres**, a minority student, to conduct two internships at GSFC during FY14. Torres presented his research at the 2015 National Space Grant Directors' annual meeting.

Annual Performance Objective − Support collaborative research proposals in NASA areas. [At least one collaborative proposal submitted]
SDSGC working in concert with SD NASA EPSCoR and NASA JPL and ARC was selected a $750,000 NASA EPSCoR major research grant project titled: *"High Performance and Durable Lithium-ion Battery for NASA Space Applications"*.

Higher Education
Annual Performance Objective − Statewide competition for Program Initiation Grants for course development offered at all 10 higher education affiliates including three Tribal Colleges; emphasis on interdisciplinary research focused on NASA, DUSEL, or EROS priorities. [At least two awards ($5,000-$20,000)]
The following six Project Innovation Grant (PIG) projects were selected among 13 affiliate proposals, all of which will be described in SDSGC's FY2014 OEPM report since the 8-page APD report limit does not allow for descriptions: 1) Journey Museum and Learning Center: *"Summer in Space"* ($13,000). 2) SDSM&T: *Green Chemistry Education Workshop for Middle School Teachers in the Rapid City Area* ($12,000). 3) DSU: *The STEM Institute: An interdisciplinary program for maximizing student recruitment and retention in STEM majors at Dakota State University* ($10,000). 4)

USD: *South Dakota Planetary Exploration Education Center* ($9,727). 5) Augustana College: *Sonia Kovalevsky Day* ($6,840). 6) SDSM&T: *Mines Experimental Rocketry Team, aka, Mines Assoc. of Rocketeers "MARS"* ($5,000).

Annual Performance Objective − Support interdisciplinary student engineering design teams in NASA priority areas. [At least three engineering design teams]
SDSGC supported **five multi-disciplinary university student teams during FY2014**.

Annual Performance Objective − Enhance faculty and undergraduate/graduate student development through planning visits, internships, and fellowships at NASA Centers.
NASA Center Internships – During FY14, the five South Dakota students conducted internships at NASA Centers: Jorel Torres and Erin Walter (Atmospheric Sciences), Trevor Jerome (Mechanical Engineering), John Lillevold (Chemical Engineering), and Douglas Kadrmas (Electrical Engineering). Eight students attended SpaceVision 2014.

NASA Education Outcome 2 Accomplishments
Precollege
Annual Performance Objective − Support statewide precollege robotics programs, including resources, teacher training workshops, and state competition. [At least 30 teams participate in SD FLL robotics state competition (400 students)]
SDSGC's annual $5,000 **Daniel Swets Robotics Materials Award** is a teacher award. The FY14 award winner(s) will be selected next month. Twenty-eight (28) middle school teams (170 students) competed in the **6th Annual SD FIRST LEGO® League (FLL) Robotics Championship Tournament**. Just over 300 students participated in SD FLL regional competitions. SDSGC's Associate Director at SDSU's Extension Office, trained 24 informal educators/volunteers in the basics of LEGO and **4-H Robotics**.

Annual Performance Objective − Sponsor statewide competition for precollege STEM teacher grant. [At least one precollege teacher grant ($5,000)]
Kelly Lane Earth & Space Science Grant – This annual $5,000 grant is awarded by SDSGC to science or math teachers in South Dakota in recognition and support of outstanding teaching and innovative STEM educational programs at the pre-college level. The 2008 winner, Julie Olson, went on to become a **Presidential Teacher of the Year recipient**, and then in December 2014, on to one of the top 50 finalists worldwide for the **$1 million Varkey GEMS Foundation Global Teacher Prize**.

Annual Performance Objective − Inspire and motivate women, underrepresented minorities, and persons with disabilities into STEM careers. [Over 1,000 females and students from underrepresented groups participate each year through Women in Science Conferences, K-12 science fairs, ACE Camp, Flandreau Indian School Success Academy, SD GEAR UP, and related programs.]
Through its subaward with the SD Discovery Center (SDDC), SDSGC partnered with local businesses to support six **Women in Science (WIS) conferences** with 2,424 girls attending during FY2014. The first annual **AstroCamp for Girls** was initiated in 2014 at SDSU as a two-day residential camp funded by Space Grant for 12 middle school girls.

Annual Performance Objective − Increase teacher capacity to effectively incorporate aerospace and earth science into the curriculum. [At least 100 teachers will participate in workshops facilitated by SDSGC such as NASA AESP training, GIS/GPS training, E-missions, GEMS, and StarLab/Digitarium/Uniview Planetarium astronomy training.]
Under SDDC's FY2014 Space Grant subaward, 156 teachers/educators participated in STEM workshops held at various locations including Sinte Gleska University and Oglala Lakota College. SDSGC's representative at SURF's Sanford Science Education Center provided NASA-related STEM workshops to over 300 educators during FY14.

Annual Performance Objective − Support programs that expose K-12 students to hands-on experiences and to educational and career opportunities in the fields of aerospace, earth science and technology.
Through the third quarter of FY2014, affiliate SD Discovery Center (SDDC) provided 132 StarLab **Planetarium programs** to 1,459 precollege students (802 girls and 657 boys, of whom 321 were minority) and 240 teachers/parents. As part of the Journey Museum and Learning Center's FY14 "precollege" planetarium program, 1,187 students were reached. SDSGC affiliate Sanford Science Education Center at SURF reached 2,500 K-12 students through **STEM field trips** and videoconferencing. SDDC held two **NASA Art & the Cosmic Connection Camps** reaching 28 elementary/middle school students. With SDSGC support, SDSM&T's 38th annual **Engineer's Week** was held Feb. 17-21, 2015, with STEM events for 600 middle and high school students.

Annual Performance Objective − Facilitate partnerships for grant applications that aim to strengthen precollege STEM education. [Annually, SDSGC affiliates will participate in at least one precollege education proposal.]
Women and Minorities in Science (WAMS) grant – SDSU's Space Grant Associate Director Christine Wood was successful in submitting a proposal selected by USDA National Institute of Food and Agriculture for a three-year $150,000 grant. She also played a key role in the 2014 **STEMwise Career Conference** for 30 precollege teachers.

NASA Education Outcome 3 Accomplishments
Informal Education Programs (Public Service)
Annual Performance Objective – Partner with informal education affiliates to disseminate NASA content, share NASA educational resources, and host major NASA science education events. [15 informal education providers and 500 students share NASA resources; 150 teachers, 2,200 students participate in NASA science education events]
South Dakota Space Days 2014 at Badlands Astronomy Festival was held at Badlands National Park on July 25-27, 2014 for 3,041 general public attendees. SDSGC's lead institution **SDSM&T** and affiliates **Journey Museum, SDDC**, and **Black Hills Astronomical Society** assisted. **SDDC's *Mentoring Minds in Motion: Teens as Teachers*** program resulting from a FY14 partnership with SD Youth Foundation to train high school students to be leaders and future teachers or scientists in STEM fields, reaching 615 precollege students and 20 teachers/parents.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Diversity of institutions, faculty, and student participants** – Two of SGSGC's ten Higher Education affiliates are Tribal Colleges. 23.8% percent of FY14 fellowships awards went to minority students and 50% to females. As a result of the February 2014 Diversity Summit, a Diversity Consortium was formed during FY14. The FY14 *Space Grant/Herrington Crazy Horse Scholarship* (named for Native American Astronaut Commander John Herrington) was awarded to Maria Teachout, a Native American junior in Applied and Computational Mathematics at SDSM&T.
- **Minority-Serving Institution Collaborations –** During FY14, Tribal College affiliate OLC pre-service teachers were brought into SDDC's Space Grant Innovative Pilot in STEM Education Project *"Rising Star Educator Program (RSEP)"*.
- **NASA Education Priority Accomplishments:**
  - **Hands-on student experiences in NASA-related STEM disciplines** that incorporate real-life problem-solving needs were provided to the following five multi-disciplinary university student teams at SDSM&T, several of which participated in national competitions during FY2014 with Space Grant support: 1) *Mines Assoc. of Rocketeers (MARS)*, 2) Robotics Team, 3) *Moonrockers* team, 4) Unmanned Aerial Vehicle Team, and 5) Autonomous Underwater Vehicle Team. Five college students conducted NASA internships. Similarly, SDSGC provided support for the previously described precollege programs: 1,516 youth engaged in SDSU's 4-H programs, 2,424 middle and high school girls attended Women in Science Conferences, 28 participated in Aerospace in Engineering Camp, 12 attended AstroCamp, and 295 Tribal high school students attended GEAR UP.
  - **Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise** –156 middle school teachers participated in SDDC STEM workshops. A workshop at OLC resulted in eight new pre-service educators recruited to SDDC's NASA *Rising Star Educator Program*. Additionally, SDDC conducted GEMS and NASA GLOBE workshops at the SD Science and Math Teachers conference and the Lakota Nations Education Conference in December 2014.
  - **Summer 2014 opportunities for secondary students on college campuses** with the objective of increased enrollment in STEM disciplines and interest in STEM careers supported by SDSGC included: 1) the 23rd annual *Aerospace Career and Education (ACE) Camp* held at SDSU with 28 high school students, 2) *2014 South Dakota GEAR-UP* residential college preparatory program held at SDSM&T with 295 high school students from 24 Tribal schools, 3) SDSU's *Ready SET (Science, Engineering & Technology) Go!* Camp, and SDSU's *Girls: Engineering, Mathematics and Science (GEMS)* for 45 8th grade girls.
  - **Community Colleges** – SDSGC worked closely with affiliate Lake Area Technical Institute (LATI) in proposing and winning a $500,000 NASA 2014 *Competitive Targeted Community College and Technical Schools* grant.
  - **Aeronautics research** – In addition to the LATI's NASA grant focusing on aviation technology described above, SDSU's aviation program received accreditation from the Aviation Accreditation Board International.

- **Environmental Science and Global Climate Change** – SDSM&T Native American alumnus and NASA fellow, Dr. Timothy Bull Bennett, briefed leaders in Washington as a lead author on the 3rd National Climate Assessment.
- **Support of innovative research infrastructure activities to enable early career faculty to focus research toward NASA priorities** – Two FY14 SDSGC "seed" grants provide early career faculty research support.

IMPROVEMENTS MADE IN THE PAST YEAR

On Oct. 20-21, 2014, the ten members of the SDSGC Management Team held its 2nd annual 1.5-day retreat to discuss the future direction of the Consortium, which among planning upcoming Consortium programs, allowed for valuable discussions the continuation of a tight or reduced budget for FY15 and beyond. In January/February 2015, SDSGC's Management Team revised the consortium's Strategic Plan to bring it up to date with current NASA education priorities.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

SDSGC is a statewide network of 19 organizations from education, industry and government. The Consortium's ten-member Management Team consists of representatives from those affiliates marked with an asterisk.

Educational Affiliates

- * SDSM&T (Lead Institution, state university BS-PhD, science and engineering; involvement in all Outcome 1, 2 and 3 programs)
- * SDSU (state university BS-PhD, agricultural and STEM institution; Outcome 1 higher education/research and Outcome 2 precollege robotics/STEM programs)
- * Augustana College (BS private liberal arts/professional college; Outcome 1 higher education/research and Outcome 2 precollege robotics/STEM programs)
- * University of South Dakota (state university BS-PhD, medicine, law, fine arts, business; management in Outcome 1 higher education/research programs)
- Black Hills State University (BS state liberal arts; Outcome 2 pre-service education)
- Dakota State University (state university, Associates-PhD, computer management)
- Northern State University (state university, BS-MS, business, education, arts and science; new affiliate with anticipated involvement in Outcome 2 higher education)
- Oglala Lakota College (Tribal College, AA-MS with STEM majors; Outcome 1)
- Sinte Gleska University (BS Tribal College, Outcome 1 and 2 programs)
- Lake Area Technical Institute (technical institute, Associate of Applied Science degrees, robotics and aviation maintenance; Outcome 1 higher education)
- * South Dakota Discovery Center (science center; Outcome 2 teacher-training)
- * The Journey Museum and Learning Center (museum; Outcome 2 and 3 programs)
- Badlands Observatory (private observatory, Outcome 1 astronomical research)
- Black Hills Astronomical Society (astronomical society; Outcome 3 public service)

State and Federal Government Affiliates

- * Sanford Underground Research Facility at Homestake (state organization under SD Science & Technology Authority; Outcome 1 research/education, Outcome 2 STEM)

- * USGS Earth Resources Observation and Science (EROS) Center (data management, systems development, and research field center; Land Processes Distributed Active Archive Center for NASA's Earth Observing System; operation of new Landsat 8 mission; Outcome 1 higher education/research in remote sensing)
- * South Dakota Board of Regents (BoR) – The following BoR offices: A) Office of Research and Economic Development, and B) Office of STEM Partnerships

Industrial Affiliates

- Raven Industries (high-altitude balloons/GPS; NASA contractor; Outcome 1 research and development in aerospace, higher education student internships)
- RESPEC (consulting & services: engineering, IT, water & natural resources; Outcome 1 research in remote sensing and higher education student internships)